COFFEE RESEARCH AND EXPERIMENTAL STATION

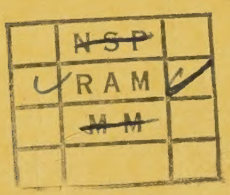
LYAMUNGU, MOSHI
TANGANYIKA

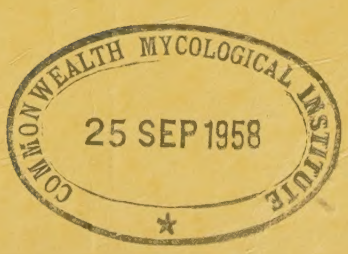
REPORT

FOR THE

SEASON

1956-57





CONTENTS

	Page
GENERAL	1
IMPROVEMENT OF PLANTING MATERIAL	2
IMPROVEMENT OF GROWING CONDITIONS	4
PRUNING EXPERIMENTS	6
SPACING EXPERIMENT	9
MISCELLANEOUS EXPERIMENTS	9
NURSERIES	10
PESTS AND DISEASES	11
VISITORS	12

STAFF

Senior Research Officer	— F. R. SANDERS, B.A. (Cantab.), Dip. Agric. (Cantab.)
Plant Pathologist	— E. A. RILEY, B.Sc. (Cape) D.I.C., Ph.D.,
Entomologist	— R. G. TAPLEY, B.Sc. (London)
Chemist	— L. J. HART, B.Sc. (London), Dip. Agric. Sc. (Cantab.), D.T.A. (Trin.)
Horticulturist	— L. M. FERNIE
Senior Field Officer	— J. I. THOMSON
Field Officers	— K. H. GROVES M. JENNER

Coffee Research and Experimental Station

Lyamungu, Moshi
Tanganyika

REPORT FOR THE 1956/57 SEASON

GENERAL

The crop season

There were three main flowerings affecting the 1956/57 crop. The first took place during the last half of November, 1955, the second near the end of December, 1955 and the third in the middle of January, 1956. An exceptionally heavy crop was set over much of the Station, and by the end of March a large proportion of the cherry had reached an advanced stage of maturity. Even at this early stage a number of trees had begun to show signs of strain due to the heavy crop which began to ripen in quantity abnormally early. Picking commenced in June and the peak was reached in August-October instead of September-November as is more usual; the stripping of certain areas had to be started in July. Including seed, but excluding buni, cherry equivalent to 97.45 tons of parchment was picked. The area in bearing was 136.5 acres. The average out-turn was 411 debes of cherry per ton of parchment.

Coffee grades and classifications

From a total of 90.41 tons of No. 1 parchment coffee sent to the mills, 73.49 tons of clean coffee was obtained; of this amount 65.5% was graded PB, AA, and A.

The quality was not good, due in part to difficulties of drying such a large crop. An award of Class 3 was obtained for 5.6% of the total crop and 65.2% was better than fair average quality.

In addition to the above, 32.50 tons of dried cherry was stripped from the trees and sold as buni.

Seed distribution

Once again there was a big demand for seed. Some 5,500 lbs. was supplied to growers. The manufacture and installation of a seed-grading machine produced a more uniform product, but hand-picking was still carried out.

The weather

After light rain during the latter half of December, 1955 a record amount of 7.22 inches was recorded in January, 1956.

Little effective rain fell in February, but the distribution in March was adequate. The long rains were initiated by a two-inch fall on April 11th and apart from a dryish spell in mid-April were reasonably well distributed. The total fall was low, amounting to 25.49 inches. Unusual hot, sunny afternoons were frequent towards the end of April and during May. The next three months were cool and in the main dry, the total rainfall recorded during this period being 5.57 inches. Apart from two effective showers near the end of September, the dry weather continued for the next two months. The last quarter yielded 2.58 inches, of which only 1.14 inches could be considered as effective rainfall, and this was spread over three days early in November. The year's total was 45.10 inches.

Lyamungu Coffee Estate

The clearing and ripping was completed by March, 1957. Eighty acres were planted with Cynodon.

Instructional courses

Short courses in processing and pruning, mainly for the district staff of the Agricultural Department, were organised at the appropriate seasons.

Research Committee

A committee set up by the Coffee Board of Tanganyika to report on the future research programme for arabica coffee in Tanganyika held its inaugural meeting at Lyamungu under the Chairmanship of Dr. E. W. Russell, Director of the East African Agriculture and Forestry Research Organization, on the 22nd and 23rd November, 1956.

Agricultural Show

The Station staged an exhibit at the Coffee Board's stand at the Trade and Agricultural Show in Moshi on the 18th and 19th October, 1956. The stand was honoured by a visit from Her Royal Highness Princess Margaret.

IMPROVEMENT OF PLANTING MATERIAL

Selection Trials

One new seedling selection trial, designed to compare the yields of the progeny of sixty different selections, of which fifty-two are new ones, was planted in April, 1956. The poor rainfall and hot sunny afternoons caused difficulties in establishment, but by the end of the season there was a good stand and reasonable growth had been made.

The recording of the other selection trials was continued.

Records for twelve seasons are available from four Latin squares in the older clonal selection trials. By taking the means of successive groups of four years, and so isolating the years in which the trees were immature, a better idea of the

capacity of the selections is obtained. Four-year periods have been taken to eliminate the effect of irregular bearing. Table 1 gives the yields of the six highest yielders in these squares.

TABLE 1.
Yields calculated in cwt. clean coffee per acre.

Progeny	Mean of 12 years	Mean of 1st 4 years	Mean of 2nd 4 years	Mean of 3rd 4 years
L 1	12.20	5.10	14.19	17.41
I 60	11.56	5.41	13.79	15.28
N 197	12.05	6.29	13.42	16.44
KP 228	12.15	6.50	14.11	15.84
H 66	14.25	8.51	15.89	18.34
N 100	11.61	5.73	14.10	14.99

The third four-year period includes two 'on' and two 'off' years.

The mean yields for the four-year periods show a progressive increase, although the increase for the third four-year period is considerably less than that of the second.

Recording will be continued to ascertain the age at which peak production is attained, and the rate at which a decline in yield may occur.

The yields given in Table 1 show that the mean for the twelve-year period is lowered considerably by the relatively poor yields during the first four-year period. In other experiments, methods to improve yields in the early years are being tried. At the same time information will be gained as to which selections are capable of yielding heavily in their early years and maintaining a high cropping level.

The outstanding feature of the external selection trials continues to be the heavy yields at Mbosho, where further increases over those of the preceding year were again recorded. The mean yield of all selections on multiple stem in the 1956/57 season was at the rate of over 30 cwt. per acre, and was again nearly double that of the single stem. The highest yield was 40.79 cwt. per acre given by N.197; this selection was also the highest on single stem with 24.15 cwt. per acre.

This trial at Mbosho was only planted in 1952 and yet three seletcions (I/255, H1, N197) have averaged over 25 cwt. per acre per annum on multiple stem for the three-year period 1954-1956.

From the external selection trials there are indications that the highest yielding progenies under Station conditions are among the highest yielders elsewhere. For example, N.197 which has proved itself a consistently high yielding Bourbon at this Station, is among the best at the high altitude trial at Kirua Vunjo and also at the low altitude trial at Mbosho. The more vigorous Kent, KP.163, has also proved its superiority over a wide range of conditions.

Breeding

Seed resulting from the selection crosses made in the 1954/55 season was sown in the nursery, but germination was again poor.

Further selection crosses were made during the 1955/56 season, but the amount of fruit set was low.

Good growth was made by the hybrids planted out in the Observation Plot in 1955, and differences of vigour are already apparent. These trees are being pruned on the single stem system, so that an easier assessment of growth factors can be made. A heavy flowering gave promise of some good first yields in 1957.

IMPROVEMENT OF GROWING CONDITIONS

(1) **Cultural Experiments**

Mulch, Irrigation, Fertilizers:

The recording of the yields from Experiment XIVA (guinea grass, elephant grass and banana trash as mulches, and compost) was continued for the purpose of assessing the residual effects of the treatments which were discontinued in 1951. The yields for the season under review were high, all plots including the control exceeding 30 cwt. per acre. The differences arising from the previous treatments were not significant, nor were they over the five-year period.

Experiment XV (mulch, irrigation), which has been treated as an observation plot since the original treatments were modified, set a good crop varying between the equivalent of 13 cwt. of clean coffee per acre for the control plots to 25 cwt. per acre for some of the mulched and irrigated plots. The trees failed to mature the crop; depending on the treatments, between 51 per cent and 91 per cent of the crop had to be stripped as buni. The presence of mulch reduced the percentage of buni, and to a lesser extent so did irrigation, except at the first level. The reason for the inability of the trees to mature a crop which was much smaller than that successfully harvested in 1954 is unexplained, unless general decline has set in.

Work by the Chemist indicated that the potassium status of coffee might well be the controlling factor in high yielding. In Experiment XVIIIB, the application of banana trash as mulch, (banana trash is known to raise the potash status of the soil after continued application) and muriate of potash at 8 oz. per tree, have not so far resulted in any increase in crop. The treatments were first applied in 1955, and it may be too early to expect any effect. The treatments were applied to mature single stem coffee under high, light shade.

In Experiment VIA the application of nitrogen and banana trash to mature single stem coffee under high light shade had no effect on yields in the 1956-57 season, the season following the initial application of the treatments.

Interplanted bananas

From Experiment XIX, which has high *Albizzia* shade and the coffee is grown on the multiple stem system, records of the effect of interplanted bananas, at two densities and with and without manure, are available for a five-year period. For this period the presence of bananas has significantly reduced the coffee yields but their effect is becoming less marked. There is now little difference between the effects of the two densities. Application of manure to the coffee and to both the coffee and bananas, has not improved the coffee yields.

Tables 2 and 3 show the effects of interplanted bananas and of manuring over the five-year period.

TABLE 2

Effect of interplanted bananas

Yields calculated in cwt. clean coffee per acre

No bananas	Bananas at 90 stools per acre	Bananas at 135 stools per acre	Mean
8.62	6.86	6.44	7.31

Least significant difference — 0.61 cwt. (P = 0.05)

TABLE 3

Effect of manure

Yields calculated in cwt. clean coffee per acre

No manure	Manure at 1 debe per tree	Manure at 2 debes per tree	Mean
7.14	7.54	7.24	7.31

Least significant difference — 0.61 cwt. (P = .05)

The experiment will have to be continued for some years before any conclusions can be drawn.

The first year's yields are available from Experiment XXIII, where bananas have been interplanted at 180 stools to the acre among coffee planted at different densities. A significant depression of coffee yields due to the presence of bananas amounted to 4.89 cwt. of clean coffee to the acre, or 24%, the effect being the same on both multiple and single stem coffee. A similar result was obtained in Experiment XIX with multiple stem coffee in its first year of bearing.

Provision was made for the recording of yields of the bananas interplanted in the coffee and from external plots. Up to the end of 1956 banana yields were very variable, and no differences due to the spacing of coffee were discernible. The overall yield of the external plots with 360 stools to the acre against 180 to the acre in the coffee showed a very slight increase only.

(2) Pruning Experiments

Experiment XIII.

This is the original experiment in which the yields from multiple and single stem pruning treatments are compared. Over the nineteen-year period the difference is highly significant in favour of the multiple stem system. As mentioned in the last report, the difference arises from the much greater crop from the multiple stem system in the first ten years of bearing.

Table 4 shows the mean yields in cwt. of clean coffee per acre for the period 1938-47 and 1948-56, and for the whole period 1938-56.

TABLE 4

	Mean 1938-47	Mean 1948-56	Mean 1938-56
Single stem	5.84	13.27	9.36
Multiple stem	10.14	12.44	11.23
Least significant difference	0.93	—	0.95

The yields in the 1956-57 season were high, the multiple stem plots cropping at 19.30 cwt. per acre and the single stem plots 17.85 cwt. per acre. The mean yields for the last three seasons have been 13.65 cwt. and 14.83 cwt. per acre respectively.

Experiment XXI

Table 5 gives the treatments and yields for Experiment XXI

TABLE 5

Yields calculated in cwt. clean coffee per acre.

	1953	1954	1955	1956	Mean of 4 years
A. Single stem—capped thrice — at 21 in., 45 in. and 72 in.	4.69	7.77	6.38	27.81	11.67
B. Single stem—capped twice — at 3 feet and 6 feet	6.30	12.07	6.89	29.04	13.58
C. Multiple stem—capped at 21 in. Three suckers from below 10 inches	2.75	11.75	16.02	36.96	16.57
E. Multiple stem—two suckers from top node	3.92	14.20	10.46	33.12	15.42
Least significant difference (P = .05)	1.51	2.29	3.57	4.76	2.02

Comparing the effects of the two single stem treatments, A and B, the results show that capping twice only result in higher crops in the first two seasons, but over the four-year period there is not a significant difference.

In the case of the multiple stem treatments, C and E, the two stems from the top node (E) gave higher yields in the first

two years but was considerably outyielded by the three stems (C) in the third and fourth years. For the four-year period the differences are not significant.

In this Experiment the plots of single and hitherto uncapped stems were capped at 6 feet and all except the top five and a half pairs of primaries were removed, with the intention of developing the umbrella habit in simulation of the Colombian system. This was done in April, 1955. In the 1956/57 season a yield of 15.42 cwt. per acre was obtained; the majority of this crop was borne on the primaries and it is a surprising yield from so small a bearing surface.

This system is being investigated in other experiments. It is obvious now that pruning in the first year or two after conversion must be aimed at length growth of the primaries so that an extensive frame for carrying secondaries is developed.

Experiment XXII

This experiment was undertaken to try out various pruning methods with a view to obtaining higher yields, particularly in the early years. It was planted with one-year-old material in April, 1953.

Table 6 outlines the treatments and shows the yields obtained so far.

TABLE 6

Yields calculated in cwt. clean coffee per acre.

	1955	1956	Mean of 2 years
A. Multiple stem—skirt plus 2 suckers from top node	4.3	29.44	16.89
B. Multiple stem—skirt plus 4 suckers	5.41	24.49	14.96
C. Multiple stem—no skirt, 4 suckers	1.02	17.08	9.05
D. Single stem—capped thrice, new sucker allowed up immediately	6.13	24.02	15.08
E. Single stem—capped thrice—development of second and third storeys delayed 6-9 months in each case	6.44	22.77	14.61
F. Single stem—capped thrice—new sucker allowed up immediately—primaries subsequently reduced to 2½ pairs below each capping	6.28	25.65	15.96
Least significant difference (P = .05)	1.30	3.33	1.95

NOTES :

(a) Skirt = the primaries below the first capping height on multiple stem.

(b) The "multiple stem, 4 suckers" treatment is obtained by capping the original stem at 21 inches, allowing two suckers from the top node, and then capping these two suckers above the second node and allowing two suckers from the top node on each.

The differences in yield between treatments B and C represent the cropping capacity of the 'skirt'. In the 1955-56 season it amounted to 4.39 cwt. per acre, and in 1956-57 it was

7.41 cwt. per acre, an average for the two-year period of 5.91 cwt. per acre. At the end of the season it was considered that the 'skirt' had played its part by giving this additional early yield, and it was then removed.

None of the single stem treatments is fully operative as yet, but the yields so far obtained show that early high crops can be obtained from this system. With the exception of treatment E in which the development of the second and third storeys is delayed, the yields are not significantly lower than the best multiple stem treatment for the two-year period.

Experiment IIIB

Although this experiment is not a pruning trial the yields obtained from the system employed are so good as to merit serious consideration.

The trees were planted in the field in April, 1951 as one-year-old plants. They were capped at a height of 21" the following year and two stems were allowed to develop from the top. Since then, the only pruning has been the removal of the lowest three pairs of primary branches arising from the two stems above the skirt, the pruning of the skirt as for single stem, and the removal of all sucker growth. As a result, the trees have become rigid and tall, necessitating the use of step-ladders for picking. There may be difficulty in effecting a change-over to the next cycle, with consequent loss of crop. It is yielding at the rate of approximately 14 cwt. per acre in the 1957/58 season. The mean yields of the three selections over the four cropping years of this experiment are as follows:—

TABLE 7

Yields calculated in cwt. clean coffee per acre.

	1953	1954	1955	1956	Mean of 4 Years
N 39	8.69	21.96	17.47	28.15	19.07
H 66	8.43	19.86	15.67	27.29	17.81
N 5	7.65	19.04	16.91	26.99	17.64
Mean	8.26	20.29	16.68	27.47	18.17
Least significant difference (P = .05)	—	1.09	—	—	0.79

It is noteworthy that, under the particular conditions, heavy cropping in the first two bearing years has not prevented high yielding in the third and fourth years.

Experiment XXIII

Each plot in this experiment (spacing) is split for multiple and single stem pruning systems. It is obvious that spacing and pruning are closely linked, and the influence of spacing during this first bearing year is likely to be less than at any time in the future. It is interesting to note that while single stem invariably outyielded multiple stem at the wide spacings, there was a tendency to the opposite at the very close spacing, even in this first bearing year.

An experiment (XXVIII) to investigate methods of increasing yields of coffee under high light shade and with interplanted bananas was commenced in March 1956. The treatments included the conversion of twenty-year-old single stem coffee to multiple stem, and two methods to try and improve yields of trees which are already 'umbrellaed'.

Spacing

In Experiment XXIII various densities ranging from 540 to 2,940 per acre are being tried. For the first year of bearing all densities of planting gave a significantly higher yield per acre than the control (540 per acre) and densities of 1,500 up to 2,940 gave higher yields per acre than a density of 960.

Table 8 gives the results for the first year of bearing; the experiment was planted in 1954.

TABLE 8

Yields calculated in cwt. clean coffee per acre.

Plants per acre	540	960	1500	2160^S	2940	2160^R	Mean
Yield per acre	12.60	16.61	20.90	23.37	23.50	20.70	19.61

Planting distances

540 = 9 x 9 feet
960 = 6′ — 9″ x 6′ — 9″
1500 = 5′ — 5″ x 5′ — 5″
2160^S = $4\frac{1}{2}$ feet x $4\frac{1}{2}$″
2940 = 3′ — 10″ x 3′ — 10″
2160^R = 3 feet in the row by 3 feet 6 inches between the row and 10 feet 3 inches between the double rows.

The condition described under Diseases as stem pitting or 'bottling' occurs in this experiment, and elsewhere on plants of similar age and younger.

(3) Miscellaneous Experiments

Experiment IB

The possibilities of rehabilitating old coffee by pruning or re-planting are being investigated. The treatments were carried out in 1955, so that yields are not yet available. It is interesting to note, however, that it is possible to develop a strong new stem on the single stem system from the base of an old stump, but two cropping years must inevitably be lost in the process.

Experiment XXIX

During the year an experiment was planted to test the effect on transplanting and subsequent growth of certain leaf and root treatments. The leaf treatments consisted of trimming and the application of a plastic spray, both by spraying and dipping, at the time of transplanting in the field. None of these leaf treatments materially assisted in the transplanting survival rate under the conditions of the experiment, which were severe.

One of the root pruning treatments, however, was very successful in maintaining a one-hundred per cent survival rate among the transplants. In this treatment the tap-root was undercut in the nursery, at a depth of 9 inches, five times at monthly intervals prior to transplanting. The effect was to eliminate, at least temporarily, the tap-root, and to cause an increased development of the lateral roots immediately above the cut. Planting was made very much easier with this type of root system, and little or no wilting occurred. It remains to be seen how the root systems of such plants will develop and how they will behave under the strain of a heavy crop.

Percentage survival rates are shown in the following table:

TABLE 9

		LEAVES			
	ROOTS	0. Leaves trimmed	1. Leaves sprayed plastic spray	2. Leaves dipped in plastic spray	MEAN
0.	Roots unpruned	80	65	80	75
1.	Tap-root undercut in nursery at 9″	100	100	100	100
2.	Tap-root cut at 9″ at transplanting	60	60	60	60
	MEAN	80	75	80	78

NURSERIES

(a) **Cuttings :**

The only material taken for rooting was for use as replacements of casualties in existing experiments.

(b) **Seedlings :**

Seed of several selections was sown for a projected fertilizer trial. Considerable damage was caused by cut-worm and by 'damping-off' disease.

(c) **Seed germination :**

(1) A further experiment on seed germination gave the following results :—

(a) A steady fall-off in viability occurred according to age of seed from 18-40 weeks. This confirms a previous finding that seed should not be kept under normal conditions for more than five months, if germination capacity is not to be unduly impaired.

(b) After six months storage, the time required to germinate was not further increased in proportion to the age of the seed. This is contrary to a previous finding which showed a high positive correlation between the age of seed and the time taken to germinate.

(c) The drying of seed in the shade gave a higher rate of germination than sun drying at all ages.

(2) At the request of the Central Experiment Station of the University of the Philippines a germination test on seed despatched from the Philippines in different forms of packing was carried out. The age of the seed before despatch and the moisture content before packing are not known. The containers used and the germination results are shown in the following table:—

TABLE 10

	Seed container	Percentage germination 11 weeks after sowing
1.	Polyethylene refrigerator bag	92
2.	Transparent shiny plastic envelope	80
3.	Glassene wax paper bag	62
4.	Brown stiff manila envelope	57

(d) **Grafts :**

At the end of the year a number of grafts were made in an attempt to ascertain whether the 'bottled' or stem-pitting condition of coffee in Experiment XXIII could be transmitted by grafting. Three hundred scions from affected trees and three hundred from apparently healthy seedlings were bench-grafted on to apparently healthy seedling root-stocks and planted in glazed propagating frames. The cleft graft was used throughout. The mortality of the scions from the affected trees was high, and it was not until the second time of re-grafting, when some recovery of the parent trees had occurred and younger wood was available, that a reasonable percentage of 'takes' was obtained. A very high percentage number of 'takes' in the controls was obtained the first time.

PESTS AND DISEASES

(a) **White Stem Borer**— (*Anthores leuconotus*) :

Coffee in the lower areas of the Station was again sprayed with Dieldrin over the bottom 18 inches of stem in March and again in November. The area was further extended in the latter spraying as some borers were found in hitherto untreated experiments.

The original borer-infested areas of the Station have been treated with Dieldrin regularly twice a year for the past three years and are now apparently free of this pest.

(b) **Antestia**—(*Antestiopsis lineaticollis*) :

Test spraying indicated a build-up of the pest after the rains, particularly in the northern part of the Station. Control was effected by incorporating D.D.T. in the post-rains copper spray.

Fig. 1.—Base of 3-year-old coffee tree showing 'bottle-like' swelling.
(Photo : R. G. Tapley)

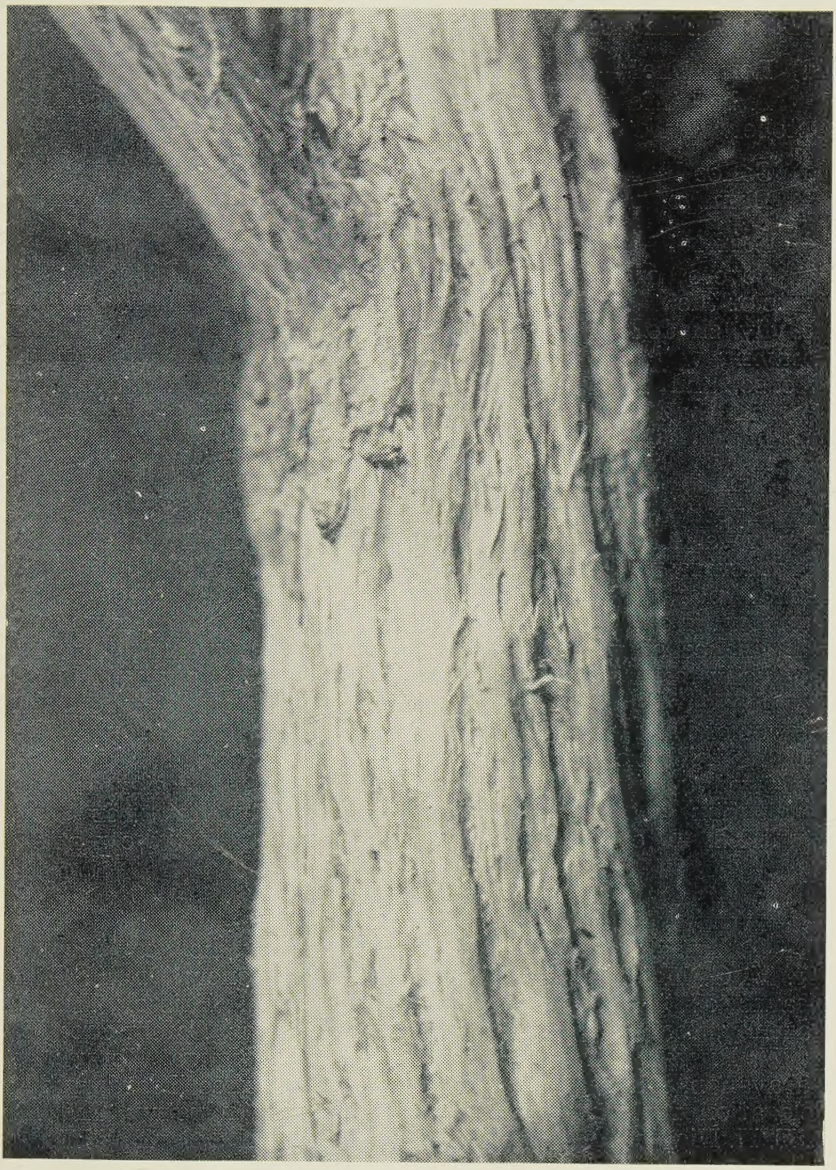


Fig. 2.—Pitting of the wood cylinder in 3-year-old coffee in the region of bark thickening.

(Photo : R. G. Tapley)

(c) **Thrips**—(*Diarthrothrips coffeae*) :

Small out-breaks occurred at the beginning of the year and again in some of the young coffee in October. Spraying with D.D.T. was an effective control.

(d) **Leaf-miner**—(*Leucoptera spp.*) :

A bad infestation occurred in some of the young coffee in October. Subsequent irrigation brought out new leaf.

(e) **Coffee Berry Moth**—(*Thliptoceras octoguttalis* et al.) :

Damage to young cherry was fairly extensive in April.

(f) **Leaf rust**—(*Hemileia vastatrix*) :

Severe infection, followed by heavy leaf-fall, occurred in parts of the Station early in the year, more particularly in fairly heavily shaded areas. The routine pre-rains and post-rains spraying with copper did little to arrest the progress of the disease, and were presumably wrongly timed. An additional spraying was carried out in December in those areas where new leaf had already appeared.

(g) **Stem pitting or 'bottling'** (Figs. 1 and 2) :

Investigation of the incidence of die-back in the 1954 plantings revealed a hitherto unknown condition in coffee. The condition seems confined to trees planted in the field since 1953; earlier plantings are not obviously affected. The general symptom is a variable degree of swelling of the main stem some 6-12 inches above ground level; above the swelling the stem gradually tapers down to the normal thickness giving a bottle-like shape to the lower portion of the main stem. By removing a layer of bark at the point of swelling, the bark is found to be unduly thickened and the wood beneath to be ridged and furrowed, or pitted. After enquiry and the submission of a full description, a similar condition has been reported from other countries. The Plant Pathologist is investigating the matter.

VISITORS

Overseas visitors to the Station during the year included Mr. V. G. Matthews, East Africa Commissioner; Dr. H. G. H. Kearns of Long Ashton Research Station, Bristol; Mr. A. Lazenby, lecturer in agricultural botany at Cambridge; Dr. E. W. Russell, Director of E.A.A.F.R.O., Muguga, Kenya; Dr. Narayanan, Director of Research, Indian Coffee Board, with a delegation representing the Indian Coffee Industry; and Mr. A. E. H. Higgins, of the Silwood Park Colonial Spraying Unit.

DETAILS AND RECORDS OF EXPERIMENTS

Statistical details of each trial are given in a supplement to this report and will be circulated in cyclostyled form.

SENIOR RESEARCH OFFICER

Coffee Research Station,
Lyamungu, Moshi.

Printed by the
Beauchamp Printing Co. Ltd. Arusha
Tanganyika